

# **U.S. Hydropower Resource Assessment for Illinois**

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## **ABSTRACT**

The U.S. Department of Energy is developing an estimate of the undeveloped hydropower potential in the United States. The Hydropower Evaluation Software (HES) is a computer model that was developed by the Idaho National Engineering Laboratory for this purpose. HES measures the undeveloped hydropower resources available in the United States, using uniform criteria for measurement. The software was developed and tested using hydropower information and data provided by the Southwestern Power Administration. It is a menu-driven program that allows the personal computer user to assign environmental attributes to potential hydropower sites, calculate development suitability factors for each site based on the environmental attributes present, and generate reports based on these suitability factors. This report describes the resource assessment results for the State of Illinois.

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## INTRODUCTION

In June 1989, the U.S. Department of Energy initiated the development of a National Energy Strategy to identify the energy resources available to support the expanding demand for energy in the United States. Public hearings conducted as part of the strategy development process indicated that undeveloped hydropower resources were not well defined. As a result, the Department of Energy established an interagency Hydropower Resource Assessment Team to ascertain the undeveloped hydropower potential. In connection with these efforts by the Department of Energy, the Idaho National Engineering Laboratory designed the Hydropower Evaluation Software (HES), which has been used to perform a resource assessment of the undeveloped conventional hydropower potential in over 30 states. This report presents the results of the hydropower resource assessment for the State of Illinois. Undeveloped pumped storage hydropower potential is not included.

The HES was developed as a tool to measure undeveloped hydropower potential regionally or by state. The software is not intended to provide precise development factors for individual sites, but to provide regional or state totals. Because the software was developed as a generic measurement tool encompassing national issues, regional and state totals must be considered judiciously; various local issues may skew undeveloped hydropower potential totals. The information for the resource assessment was compiled from the Federal Energy Regulatory Commission's Hydroelectric Power Resources Assessment database and several other sources. Refer to DOE/ID-10338, the User's Manual (Francfort, Matthews, Rinehart 1991) for the specifics of the software and to DOE/ID-10430.1, the Status Report (Conner, Francfort, Rinehart 1996) for an overview of all resource assessment activities to date.

## Model Development

Hydropower Evaluation Software, both a probability-factor computer model and a database, is a menu-driven program that is intended to be user-friendly. Computer screens and report-generation capabilities were developed to meet the needs of users nationwide. The software uses environmental attribute data to generate an overall project environmental suitability factor (PESF) between 0.1 and 0.9, where 0.9 indicates the highest likelihood of development and 0.1 indicates the lowest likelihood of development. The suitability factors are dependent on the unique environmental attributes of each potential site. They reflect the considerations that (a) environmental concerns can make a potential site unacceptable, prohibiting its development (for a suitability factor of 0.1), or (b) if there are no environmental concerns, there is no effect on the likelihood of site development (for a suitability factor of 0.9). A combination of attributes can result in a lower suitability factor because multiple environmental considerations would reduce the likelihood that a site may be developed to its physical potential.

## Model Goal

The goal of the HES is to assemble an accurate resource database of all sites with undeveloped hydropower potential in the United States for use as a planning tool to determine the viable national hydropower potential. Undeveloped hydropower potential is not limited to the development of new sites; it also includes the development of additional hydropower-generating capacity at sites that currently have hydropower, but are not developed to their full potential. This undeveloped hydropower potential is a source of nonpolluting, renewable energy available to meet the growing power needs of the United States. The HES should help make this goal obtainable and ensure a set of uniform criteria for national assessment.

## Dam Status

The effects of environmental attributes vary by dam status. The dam status classifications used are as follows

- W = Developed hydropower site with current power generation, but the total hydropower potential has not been fully developed. Only the undeveloped hydropower potential is discussed in this report.
- W/O = Developed site without current power generation. The site has some type of developed impoundment or diversion structure, but no developed hydropower generating capability.
- U = Undeveloped site. The site does not have power generation capability nor a developed impoundment or diversion structure.

## ASSESSMENT RESULTS

### Summary Results

A total of 49 sites (Table 1) have been identified and assessed for their undeveloped hydropower potential. The HES results for individual site capacities range from 107 kilowatts (kW) to 60 megawatts (MW). The majority of the

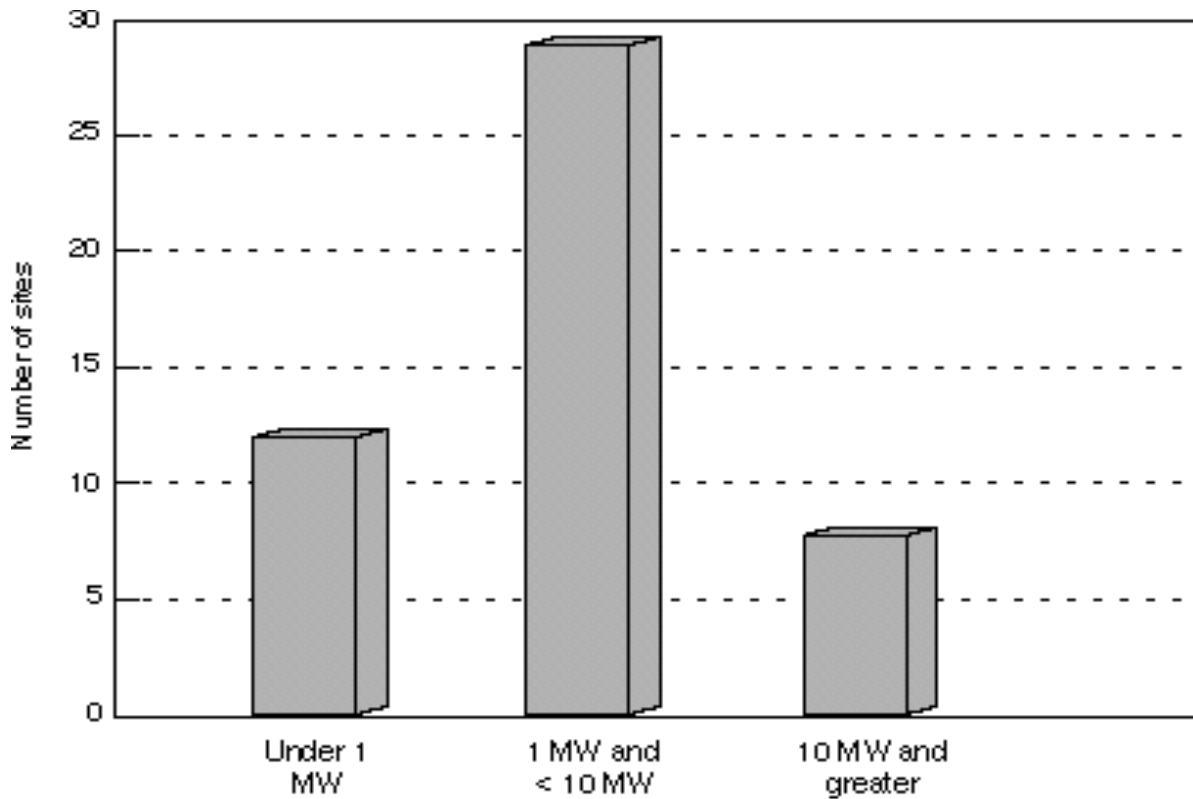
sites (59%) have potential capacities of greater than 1 MW, but less than 10 MW (Figure 1).

The nonmodeled undeveloped hydropower potential total for Illinois was identified as 594 MW. The HES results lowers this estimate about 49% to 301 MW. The greatest reduction in undeveloped hydropower potential, by MW, occurs at sites with some type of structure in place, but no current generation of power present (without power category). These sites have an HES-modeled undeveloped hydropower potential of 242 MW, a 215 MW reduction in the estimated undeveloped hydropower potential (Figure 2). The undeveloped sites have the greatest percentage decrease in modeled undeveloped potential capacity. The unadjusted potential is 58 MW, and the modeled capacity is 18 MW, a 69% decrease in capacity (Figure 2). The number of sites does not change, only the identified undeveloped hydropower potential is reassessed (Figure 3).

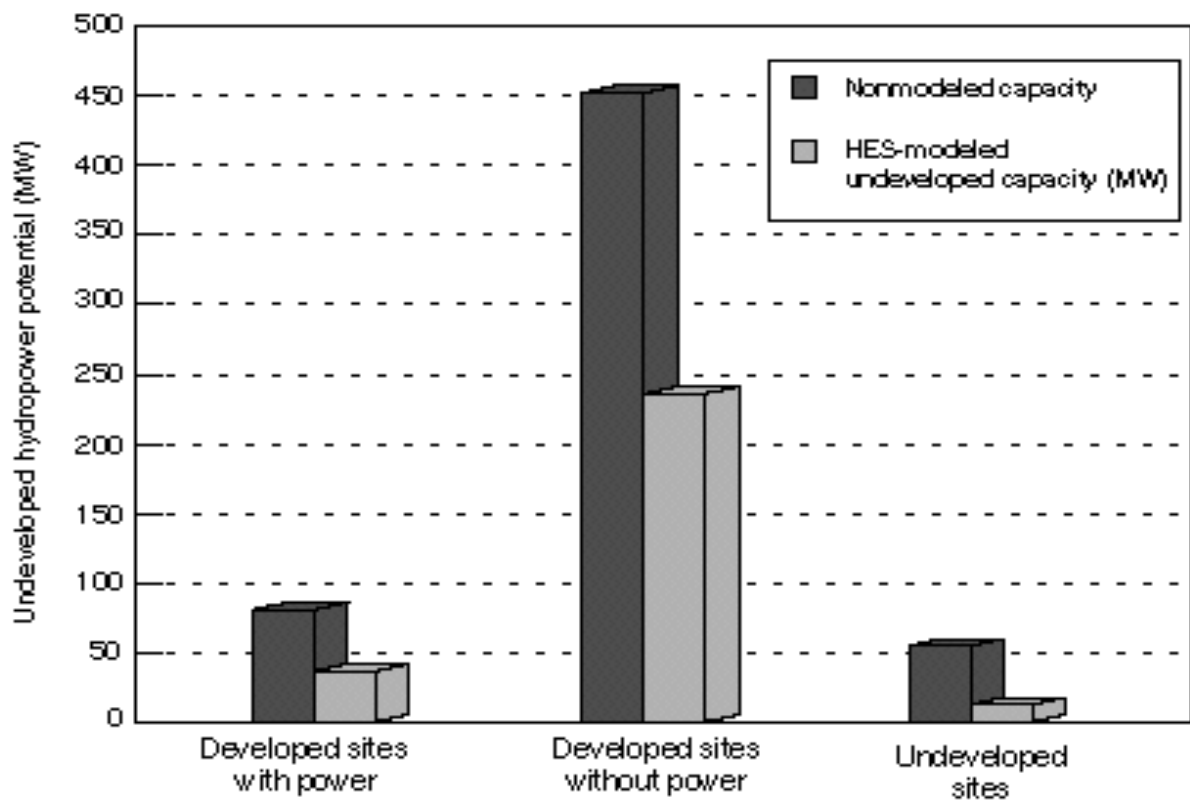
The 49 identified sites are located within 9 major river basins and 1 minor river basin. The Dayton Project on the Fox River (Figure 4) illustrates a developed Illinois hydropower plant. The number of sites per major river basin ranges from 1 in the Meramec and Ohio Main Stream River Basins, to 22 in the Illinois River Basin (Figure 5). The Mississippi River Basin has the most undeveloped hydropower potential (110 MW) of the Illinois river basins (Figure 6). It should be noted that the Mississippi River Basin reports to having only 3 sites to develop in order to obtain the 110 MW of undeveloped hydropower capacity.

**Table 1.** Undeveloped hydropower potential summaries for Illinois. The table contains the nonmodeled undeveloped nameplate potential and the HES-modeled undeveloped hydropower potential totals.

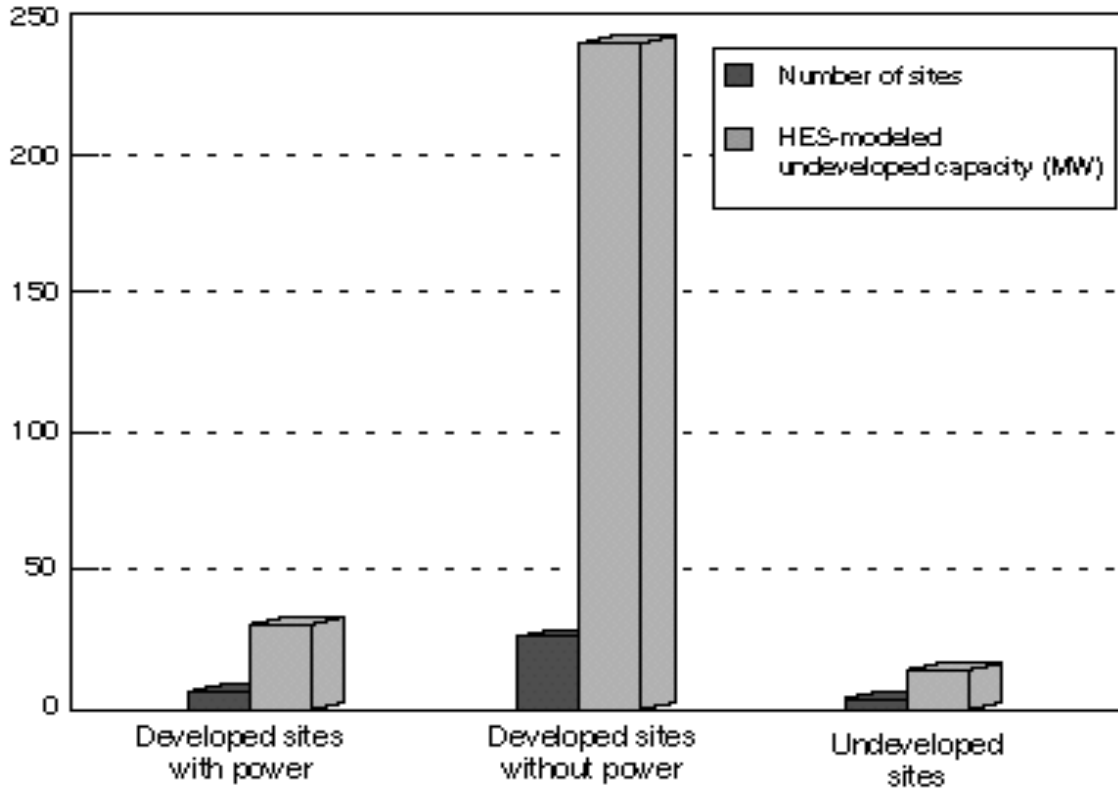
	Nameplate potential		HES-modeled potential
	Number of projects	(MW)	(MW)
With Power	9	80.1	41.4
W/O Power	35	456.7	242.0
Undeveloped	5	57.6	17.5
<b>State Total</b>	<b>49</b>	<b>594.4</b>	<b>300.9</b>



**Figure 1.** Number of sites, by capacity groups, with HES-modeled undeveloped hydropower potential.



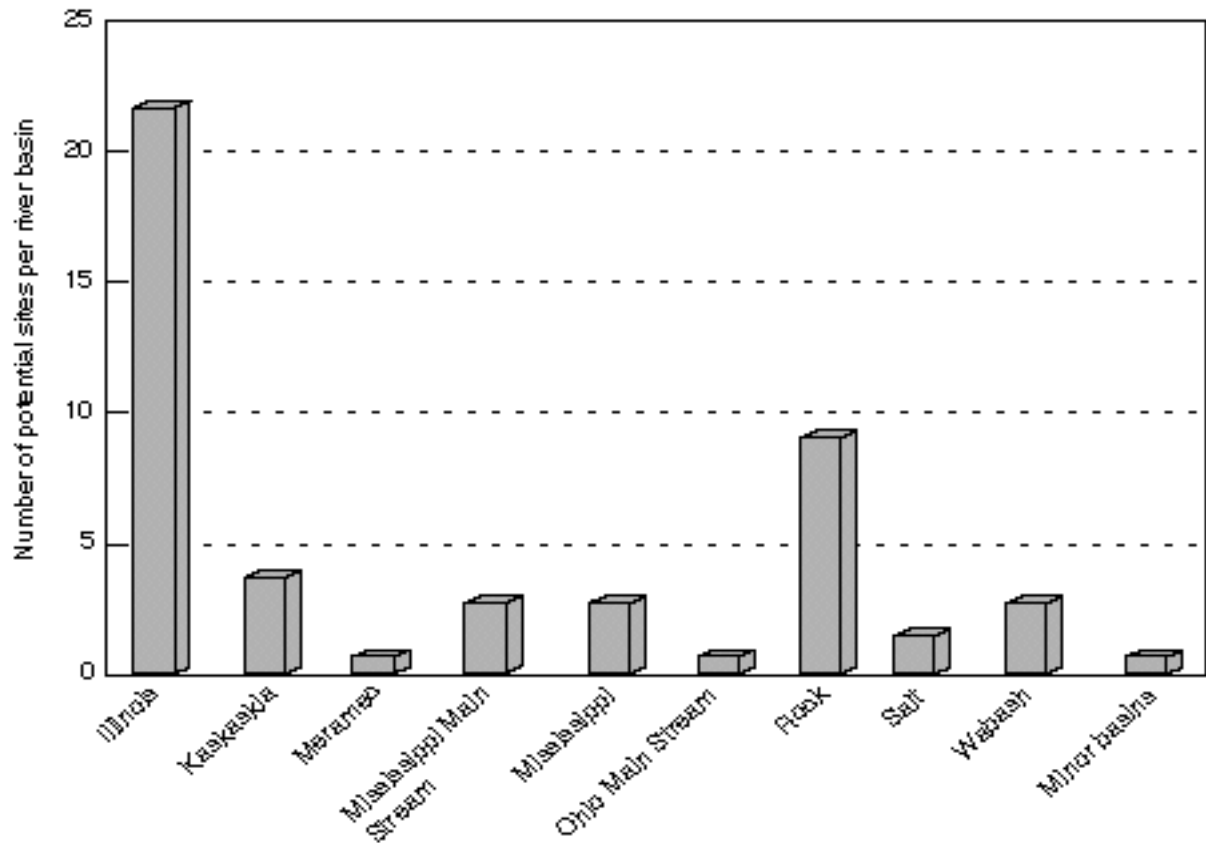
**Figure 2.** The nonmodeled and HES-modeled undeveloped hydropower potential.



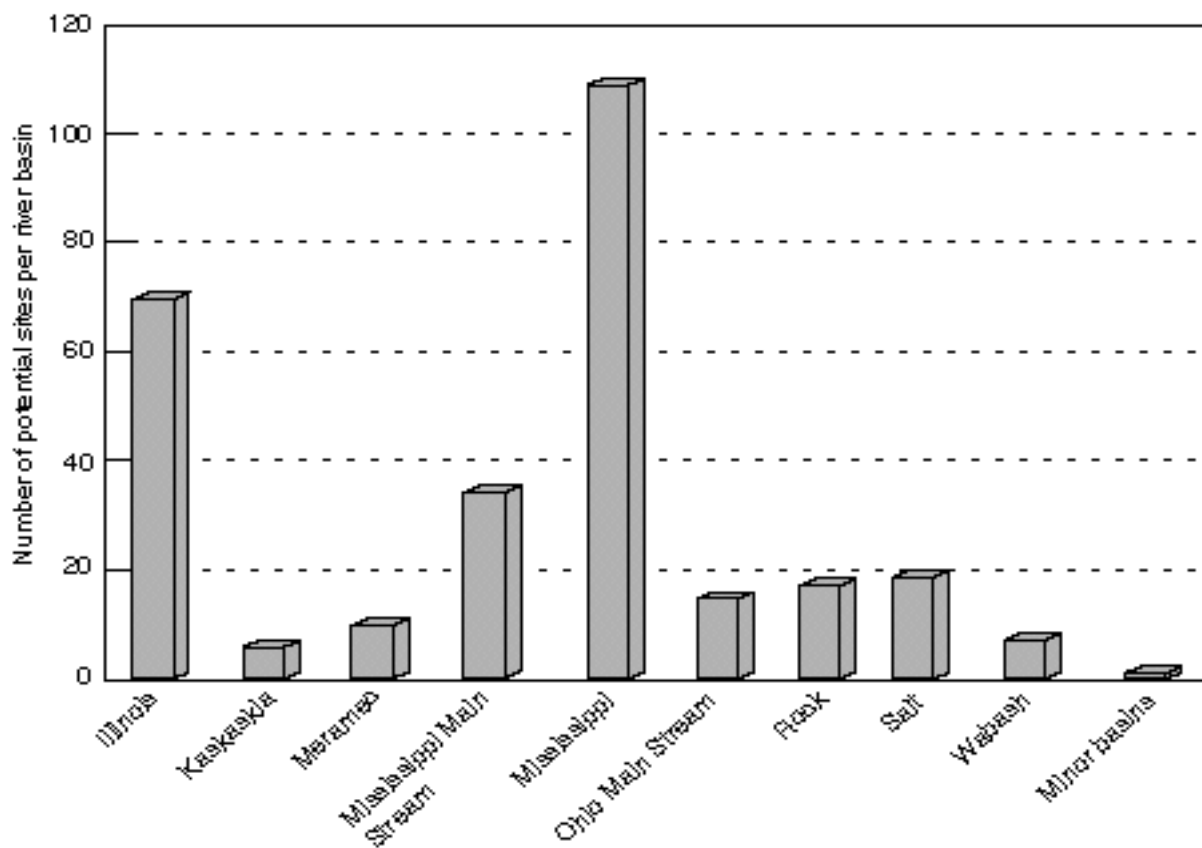
**Figure 3.** The number of sites with undeveloped hydropower potential and the total megawatts of HES-modeled undeveloped hydropower potential.

**Figure 4.** The Dayton Dam on the Fox River is an example of a developed Illinois hydropower plant. The photo shows the Dayton power plant on the left side and the Dayton Reservoir dam in the background. The Dayton plant (FERC #287) was constructed in the 1920s and has a nameplate rating of 3.6 MW. It has an additional undeveloped capacity of 630 kW at this 23-foot structure.





**Figure 5.** Number of sites with undeveloped hydropower potential in the Illinois river basins.



**Figure 6.** Megawatts of HES-modeled undeveloped hydropower potential in the Illinois river basins.

## DETAILED RESULTS

The appendices contain, in the form of HES-generated reports, detailed information about the undeveloped hydropower potential in Illinois. The appendices contain the following information:

**Appendix A** summarizes the undeveloped hydropower potential by dam status groups. The number of sites, nonmodeled undeveloped hydropower potential, and HES-modeled undeveloped hydropower potential is provided based on the dam status.

**Appendix B** provides the hydropower resource assessment by river basin, which includes the project number, project name, stream name, dam status, nonmodeled undeveloped hydropower potential, and the HES-modeled undeveloped hydropower potential for each of the individual sites. Subtotals are provided for each river basin.

**Appendix C** provides the hydropower resource assessment by FERC number, which includes the project numbers, plant name, stream name, if a site is Federally owned, nonmodeled undeveloped hydropower potential, and HES-modeled undeveloped hydropower potential. The sites are grouped by dam status.

**Appendix D** contains a resource database list for each of the 49 sites in Illinois. Information includes plant name, stream, state, county, river basin and owner names, project number, name plate and HES-modeled undeveloped hydropower potential, the unit and plant types, dam status, latitude, longitude, and the environmental factors that the HES uses to determine the project environmental suitability factor.

## OBTAINING INDIVIDUAL STATE INFORMATION

Additional copies of the hydropower resource assessment results for individual states are available and can be obtained by writing or calling the authors or the National Technical Information Service (NTIS).

**Telephone Orders**—(703) 487-4650. NTIS sales desk and customer services are available between 8:30 a.m. and 5:00 p.m., EST.

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## **ADDITIONAL HYDROPOWER EVALUATION SOFTWARE INFORMATION**

Additional information concerning the HES can be obtained by contacting Ben Rinehart or Jim Francfort at the addresses provided below. Copies of the software and the User's Manual may also be obtained from these individuals.

Ben Rinehart, Project Manager  
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Jim Francfort  
Idaho National Engineering Laboratory  
P.O. Box 1625, MS 3830  
Idaho Falls, ID 83415-3830  
(208) 526-6787

Information concerning the State of Illinois' involvement with the resource assessment or about the identified sites may be obtained by contacting:

Robert Dalton  
State of Illinois  
Chief of the Downstate Regulatory Program  
Division of Water Resources  
Springfield, IL 62701  
(217) 782-3863



## REFERENCES

Conner, A. M., J. E. Francfort, and B. N. Rinehart, 1996, *Uniform Criteria for U.S. Hydropower Resource Assessment, Hydropower Evaluation Software Status Report-II*, DOE/ID 10430.1, Idaho National Engineering Laboratory, Idaho Falls, Idaho.

Francfort, J. E., S. D. Matthews, and B. N. Rinehart, 1991, *Hydropower Evaluation Software User's Manual*, DOE/ID-10338, Idaho National Engineering Laboratory, Idaho Falls, Idaho.

# **Appendix A**

## **Summary Report**



**Appendix B**  
**River Basins Report**





**Appendix C**  
**Illinois Sites List**



**Appendix D**  
**Individual Resource Database List**

